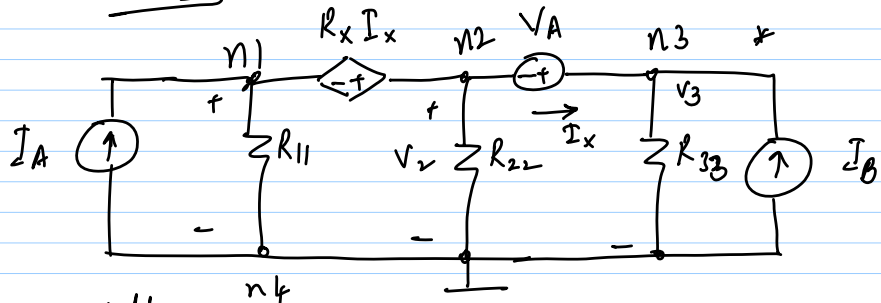


30/11/15

Lec 8

CCVS



addl. eq:

$I_x$  is unknown

Modified Nodal Analysis (Computer)

- \* KCL @ all nodes
- \* May add extra variables if needed

1)

$$[G] \cdot \bar{V} = \bar{I}$$

$$\underbrace{\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}}_{\text{element stamp}} \begin{bmatrix} V_a \\ V_b \end{bmatrix} = \begin{bmatrix} +I_o \\ -I_o \end{bmatrix}$$

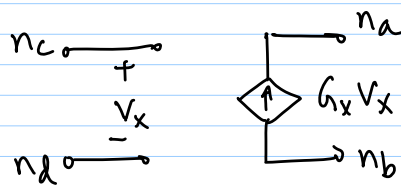
2)

$$\begin{bmatrix} G & -G \\ -G & G \end{bmatrix} \begin{bmatrix} V_a \\ V_b \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

3)

$$\begin{bmatrix} 0 & 0 & +1 \\ 0 & 0 & -1 \\ 1 & -1 & 0 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ I_v \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ V_0 \end{bmatrix}$$

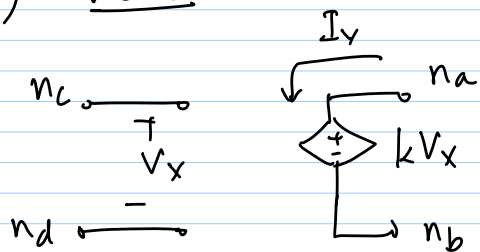
4) VCCS



KCL @ na

$$\begin{bmatrix} 0 & 0 & -G_x & +G_x \\ 0 & 0 & +G_x & -G_x \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_c \\ V_d \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

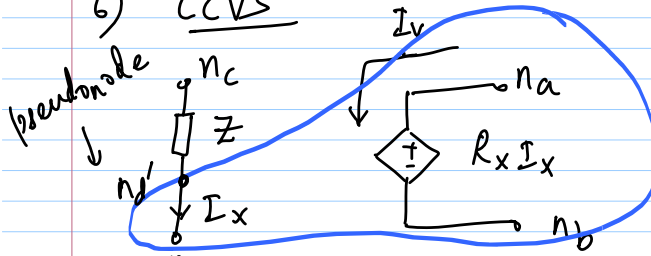
5) VCVS



$$V_a - V_b - k(V_c - V_d) = 0$$

$$\begin{bmatrix} 0 & 0 & 0 & 0 & +1 \\ 0 & 0 & 0 & 0 & -1 \\ 1 & -1 & -k & +k & 0 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_c \\ V_d \\ I_v \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$$

6) CCVS



$$\underline{CCVS} \quad V_a - V_b - R_x I_x = 0$$

$$\text{KCL @ } \begin{matrix} na \\ nb \\ nd' \\ nd \\ CCVS \end{matrix} \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & +1 \\ 0 & 0 & 0 & 0 & 0 & -1 \\ 0 & 0 & 0 & 0 & +1 & 0 \\ 0 & 0 & 0 & 0 & -1 & 0 \\ 1 & -1 & 0 & 0 & -R_x & 0 \\ 0 & 0 & 1 & -1 & 0 & 0 \end{bmatrix} \begin{bmatrix} V_a \\ V_b \\ V_{d'} \\ V_d \\ I_x \\ I_v \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$